World Construction Forum 2019
BUILDINGS AND INFRASTRUCTURE RESILIENCE
Ljubljana, Slovenia
8 – 11 April 2019
WFEO / FMOI
IZS
Univerza v Ljubljani
Fakulteta za gradbeništvo in geodezijo

# IMPLEMENTATION OF MULTIDISCIPLINARY APPROACH FOR DETERMINATION OF LANDSLIDE HAZARD

**Authors:** Tina PETERNEL[1], Jernej JEŽ[1], Blaž MILANIČ[1], Anže MARKELJ[1], Jošt Sodnik[2,3], Matej MAČEK[3], Mateja JEMEC AUFLIČ[1]

[1] Geological Survey of Slovenia, tina.peternel@geo-zs.si; [2] Tempos, Environmental Civil Engineering Ltd., jost.sodnik@tempos.si; [3] University of Ljubljana, Faculty of Civil and Geodetic Engineering, matej.macek@fgg.uni-lj.si

| Forum topics | | |
|---|---|---|
| | ☐ Energy in 21st Century | ☐ Cultural Heritage in Digital World |
| | ☐ Engineering Capacity Building | ☒ Disaster Risk Management & Governance for Resilient Communities |
| | ☐ Construction 4.0 | ☐ BIM Lifecycle, Facility & Asset Management |

**Abstract:** (250 to 500 words: for each heading use the bullet points or narrative - the submission including graphics should not exceed one page)

| | |
|---|---|
| Problems - Issues / Challenges-Needs | The aim of this paper is to present investigations and modelling of slope mass movements in the hinterland area of the Koroška Bela settlement (Bela torrent watershed) that is located on torrential fan in the Karavanke mountain ridge in north-western Slovenia. The hinterland of Koroška Bela settlement has complex geological and tectonic conditions. The active landslides are mainly related to soft fine-grained and tectonically deformed clastic rocks, most of which are covered with large quantities of carbonate scree material. Based on the investigation and field observation, the most active landslides of the Bela stream hinterland are considered to be the Urbas and Čikla landslides. Based on investigations herein, previous research and historical evidence have showed that the area of interest could present source areas of potential debris flow that could be triggered by extreme events (such as extreme precipitation events, earthquake or combination of both). A debris flows present a direct hazard for underlying settlement with 2,200 inhabitants and developed infrastructure (international railway) and industry (steel industry). With this potential risk in mind, monitoring the sliding mass, assessing the volume of active landslides and the potential hazard is crucial for effective disaster risk management. |
| Solutions - Methods / Results - Findings | In order to assess the hazard for underlying village, a multidisciplinary approach using engineering geological and geophysics investigation, hydrogeological and geotechnical monitoring was applied. Firstly, an engineering-geological mapping was applied in order to identify areas prone to slope mass movements and to determine location and type of investigation (geomechanical boreholes, geophysical investigations). The entire hinterland of the Koroška Bela settlement was geologically mapped at scale 1:5,000, while selected important landslides were mapped at scale 1: 1,000 (the Urbas and Čikla landslide). Secondly, the core drilling and core logging of 7 boreholes and excavation of 2 trenches were applied at the Urbas and Čikla landslides. Based on core logging we identify the main lithological units and sliding surfaces of both landslides. Furthermore, the thickness of lithological layers was determined using geophysical surveys. The 4 boreholes were equipped with inclinometers or piezometers which were beneficial to interpreted subsurface conditions, absolute displacement rates and measurements of ground water levels were interpreted based on 4 boreholes equipped with inclinometers or piezometers. Additionally, geomechanical properties were determined using laboratory tests such as soil suctions, grain size analysis, edometer test, direct shear test and permeability based on samples collected from the boreholes and trenches. Based on geological survey, results in geotechnical lab and hydrological model of the area, potential debris flow scenarios (magnitude, rheological characteristics) from Čikla and Urbas were determined. Mathematical model Flo-2D was applied to simulate these potential debris flow events. Modeling results show that potential debris flows with previously mentioned magnitudes would have catastrophic consequences on Koroška Bela torrential fan. Simulated depths of potential debris flow exceed 5m in some densely populated parts of the Koroška Bela fan. Therefore, application of mitigation measures is inevitable. |
| Novelty - Value / Relevance to ... | Investigation of landslide kinematics from their origin to the deposition areas is becoming crucial to reduce human loss from landslides and to assess landslide hazard. In doing so, the following questions are pursued: where can landslides occur (place of origin), when (rheological properties of material, rainfall), how extensive can they be (magnitude), and where can landslides act (place of action)? When searching for the answers to these questions, a comprehensive interdisciplinary approach is one of the most reasonable solutions on which experts and the science of landslide dynamics should focus more attention both in Slovenia and internationally. In such complex mountain morphological, geological, hydrological and urbanistic setting interdisciplinary approach is crucial for the efficient disaster risk management. Detail spatial basis serves as the most important input for planning and design of needed mitigation or protective construction measures. |

Forum statement

Acknowledgments:

The surveys within this study were conducted in the frame of a project financed by the Ministry of the Environment and Spatial Planning and the ARRS project (grant. no. J1-8153, duration: 1.5.2017–30.4.2020) financed by the Slovenian Research Agency.

**Keywords:** (up to 5 keywords)

landslide; hazard; monitoring; hinterland of Koroška Bela, NW Slovenia